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FEAP: Roof Maintenance Systems

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A Demonstration of ROOFER, an Engineered Management System for Bituminous Built-Up Roofs

by
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The U.S. Army has a very large inventory of bituminous built-up roofs. Repairs and reconstruction are steadily increasing as the roofs approach the end of their service lives, making it increasingly important to better manage maintenance funds. There is a need for a systematic procedure to determine priorities and select repair strategies that will ensure a maximum return on investment. In response, the U.S. Army Construction Engineering Research Laboratory (USACERL) has developed ROOFER, an engineered management system for built-up roofs.

This report demonstrates the ROOFER procedures on selected buildings at three different Army installations: Fort Meade, MD; Fort Lee, VA; and New Cumberland Army Depot, PA. The work was performed in three phases: (1) field work, (2) data processing and management, and (3) system turnover to installation personnel.

The Facilities Engineering Applications Program (FEAP) demonstrations proved to be a successful implementation of the ROOFER program. ROOFER evaluates membrane, flashing, and insulation indexes separately, providing an ideal base to generate repair and replacement recommendations. The Roof Condition Index, which combines the three indexes, provides the information needed for effective network management. It is recommended that ROOFER be released for use at all military bases and private civilian sites.

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FOREWORD

This demonstration was conducted for the U.S. Army Engineering and Housing Support Center (USAEHSC), under Facilities Engineering Applications Program (FEAP), Project F89, "Roof Maintenance Systems." The USAEHSC Technical Monitor was Robert Lubbert, CEHSC-FB.

The work was conducted by the Engineering and Materials Division (EM), U.S. Army Construction Engineering Research Laboratory (USACERL) with the assistance of USAEHSC and the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL). Mr. Donald Brotherson is the Director of the Building Research Council, University of Illinois. Dr. Paul A. Howdyshell is Acting Chief of USACERL-EM.

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COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L. R. Shaffer is Technical Director.

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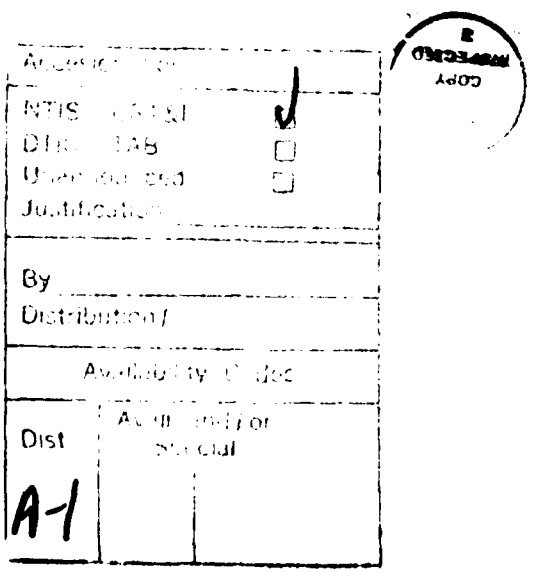

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1 INTRODUCTION

Background

ROOFER is an engineered management system that provides several functions for analyzing and evaluating built-up roofing systems. It was developed to support Army installation Directorate of Engineering and Housing (DEH) personnel in the activities associated with maintaining networks of roofs. ROOFER provides methods for creating a roofing inventory, conducting inspections, identifying roof problems (distresses), evaluating roof condition, and determining Maintenance, Repair, and Replacement (MRR) needs.

The U.S. Army Construction Engineering Research Laboratory (USACERL) developed ROOFER with the assistance of the U.S. Army Engineering Housing Support Center (USAEHSC) and the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL), using techniques previously employed for the development of PAVER,[1] an engineered management system for pavements. After several rounds of field testing and refinement of the ROOFER procedures at various Army, Navy, and Air Force bases in several geographic locations, a demonstration program was established at three Army installations: Fort Meade, MD; Fort Lee, VA; and New Cumberland Army Depot, PA. The demonstration was conducted using the Facilities Engineering Applications Program (FEAP).

The ROOFER system is described in USACERL Technical Report M-90/04.[2]

Objective

The objective of this investigation was to demonstrate the ROOFER system, including:

1. Inventory collection and inspection procedures,
2. Data processing and management procedures,
3. Development techniques for MRR recommendations, and
4. Implementation of ROOFER by Architect/Engineer (A/E) personnel (contract).

An evaluation of the procedures, worksheets, and automated microcomputer application, and the recommended specifications for the implementation of ROOFER was also accomplished.

Approach

Twenty buildings at Fort Meade, fourteen at Fort Lee, and nine at New Cumberland Army Depot were selected for this study. The work was divided into three phases: (1) field work, (2) data processing and management, and (3) system turnover to installation personnel. An A/E firm and a commercial laboratory were contracted to perform Phases 1 and 2 with assistance from the project team which included personnel from USACERL, USACRREL, and USAEHSC. The use of private contractors permitted an objective

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[1] M.Y. Shahin and S.D. Kohn, *Overview of the PAVER Pavement Management System and Economic Analysis of Field Implementing the PAVER Management System*, USACERL Technical Manuscript M-310/ADA116311 (USACERL, March 1982).

[2] D.M. Bailey, et al., *ROOFER: An Engineered Management System for Bituminous Built-Up Roofs*, USACERL Technical Report M-90/04 (USACERL, December 1989).

evaluation of the procedures and provided guidelines for future implementation of ROOFER by A/E contractors. The project team performed Phase 3, which allowed them to evaluate the efficiency of the ROOFER system and to identify problems in the microcomputer software being developed at that time.

Scope

This report describes the three phases of the FEAP demonstration. It does not describe the ROOFER program or its development.

Mode of Technology Transfer

It is expected that ROOFER will be used at both military and civilian sites. The work is expected to be performed by A/E contractors familiar with ROOFER or by in-house personnel who have attended ROOFER training sessions. A training course is currently being developed by USACERL. A ROOFER support center has been established to perform services such as distributing software updates, resolving problems, and answering technical questions concerning ROOFER.

2 FIELD WORK

The field work necessary to implement ROOFER involves two steps: office preparation and data collection. As part of the field work, an in-process review was conducted early in the data collection phase to ensure that the work was being executed properly.

Office Preparation

Careful preparation is essential to a successful ROOFER implementation. The time devoted to preparation will significantly reduce the effort needed to complete the data collection phase of ROOFER. For these ROOFER demonstrations, the office preparation included an initial site visit, development of the roof network, A/E training, and establishment of a work plan.

Initial Site Visit

The project team visited each site to establish liaison with the DEH and perform necessary groundwork to initiate the demonstration project. DEH personnel were briefed on all aspects of the ROOFER system and the demonstration project. Once they were familiar with the program objectives, they assisted in selecting several buildings having built-up roofs of varying ages to be used in the demonstration. The numbers of the project buildings for the three sites are shown in Table 1. A full day was spent at each site completing this work.

Table 1

Demonstration Building Numbers

Fort Meade	Fort Lee	New Cumberland Army Depot
Bldg 38	1110	Bldg 1
68	2609	21
82	4229	54
85	4300	81
393	4320	85
1251	5000	351
2239	6250	400
2786	7118	406
2791	8130	411
4407	8150	
4550	8151	
4707	8402	
6330	9035	
6600	12400	
8465		
8478		
8501		
8542		
9804		
9829		

Roof Network Development

The roof network for each site, as defined for this demonstration project, consisted of all the built-up roofs on the project buildings. Each building's roof was divided into sections. This allowed individual roof sections to be evaluated separately and MRR requirements to be determined, independent of adjacent roof sections. The selected roofs were sectioned using existing roof plans and aerial photographs. Each section was assigned a letter designation. Small areas with similar characteristics, such as entrance canopies, were combined into one section or combined with a larger adjacent roof area. Very large roofs without obvious sections, such as the warehouses at New Cumberland Army Depot, were arbitrarily divided into sections of approximately 20,000 sq ft (1860 m^2).

A/E Training

An architectural firm was employed through an Indefinite Delivery Order administered by USAEHSC. The requirements of the contract included preparation of the roof section plans, completion of the inventory data collection, field inspections, and calculation of condition indexes.

A training session was set up at Fort Meade for the A/E contractor and DEH personnel from the installations. The training was conducted by the project team and a private roofing consultant. The first day of the training session was spent in a classroom setting where the following topics were covered:

1. ROOFER background,
2. Inventory procedures,
3. Visual inspection procedures,
4. Insulation inspection procedures,
5. Calculation of condition indexes, and
6. Preparation of reporting forms.

The second day of instruction was spent on a built-up roof. The training staff demonstrated the visual inspection procedure and distress identification techniques discussed the previous day. The "students" were grouped into teams of two, an inspector and a recorder, and were given opportunities to apply the ROOFER inspection and recording techniques under the supervision of the training staff.

Work Plan

At the close of the A/E training session, a work plan was established whereby two or three inspection teams from the A/E firm would do the inventory data collection and visual inspections. Assistance would be provided by DEH personnel in obtaining as-built drawings and other contract documents to complete the inventory. To complete the insulation inspections, USAEHSC would conduct the aerial infrared (IR) inspections of each project building and a laboratory subcontractor would remove the necessary core samples and perform the moisture testing. The work would be completed first at Fort Meade, then at Fort Lee and New Cumberland Army Depot.

Data Collection

The data collection process involved gathering inventory information and performing the insulation and visual inspections. This information would provide the data base necessary to assess the condition of the roofs and determine MRR requirements. An established set of procedures, forms, and worksheets were employed.

Inventory

The inventory is the backbone of the ROOFER system. It provides physical and historical information needed to develop repair and replacement projects as well as determine long-term trends and experiences for specific building types and roofing systems. Procedures for establishing the inventory are documented in USACERL Technical Report M-90/04.[3]

General information on each project building was collected and entered on a Building Identification Sheet (Figure 1). A building roof plan showing each roof section and overall dimensions was also developed and put on a separate sheet (Figure 2).

BUILDING IDENTIFICATION					
INSTALLATION NO. 24355		INSTALLATION NAME FORT MEADE, MD.			
BUILDING NO. 4407		BUILDING NAME TELEPHONE EXCHANGE			
DESIGN CAT. CODE 13180		FACILITY NO. P-4407		FACILITY SUFFIX —	
LOCATION LLEWELLYN AVE.					
USE TELEPHONE EXCHANGE / BASE OPERATOR'S					
DATE ORIG. CONST. JAN. 1955		EXTERIOR WALLS MASONRY			
ROOF SECTIONS					
A	7,028 SQ. FT.	F	SQ. FT.	K	SQ. FT.
B	258 SQ. FT.	G	SQ. FT.	L	SQ. FT.
C	SQ. FT.	H	SQ. FT.	M	SQ. FT.
D	SQ. FT.	I	SQ. FT.	N	SQ. FT.
E	SQ. FT.	J	SQ. FT.	O	SQ. FT.
REMARKS					
1. THE ROOF STRUCTURE COMPONENTS SHOWN UNDER THE 'ROOF SECTION IDENTIFICATION' ARE APPLICABLE ONLY TO PART OF ROOF SECTION 'A' (BOUNDED BY DIMENSIONS 119'-10" x 49'-4") THE REMAINDER OF ROOF SECTION 'A' HAS A POURED CONC. ROOF SLAB, 5½" POURED CONC. DECK & 2" RIGID INSULATION.					
2. ORIGINAL BUILDING DRAWINGS WERE UNAVAILABLE FOR ROOF SECTION "B".					
3. IN SECTION A, TERRA COTTA COPING IS INTEGRAL W/ BASE FLASHING & COPING IS IN POOR CONDITION @ JOINTS TYPICALLY.					

Figure 1. Completed Building Identification Sheet.

[3]D. M. Bailey, et al.

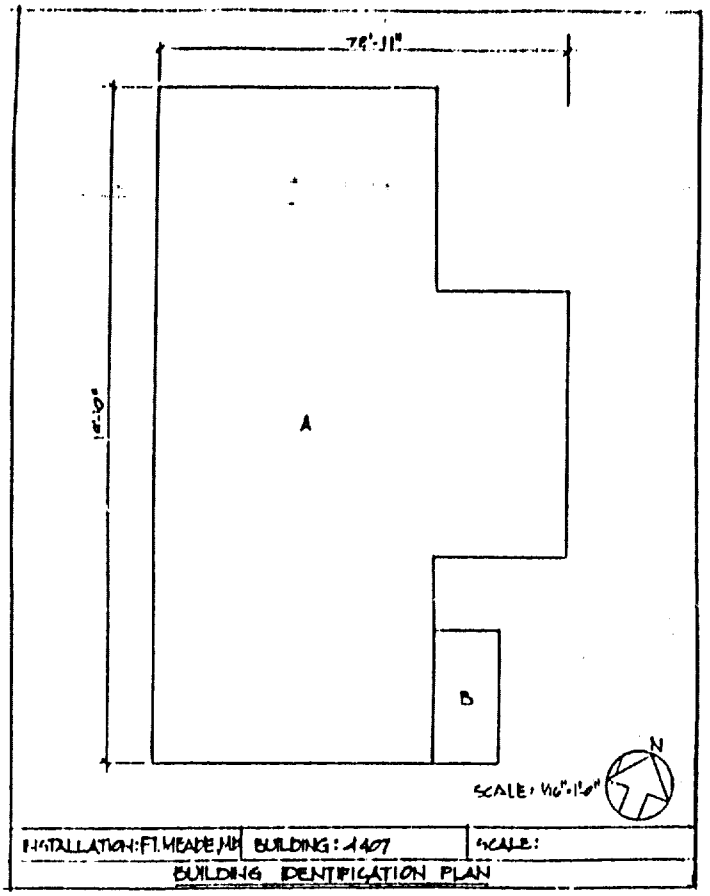

Figure 2. Building Identification Plan.

After the building information was obtained, more detailed data was collected for each roof section. These data included information on structural frame, roof deck, vapor retarder, insulation, membrane, and flashing systems. A sample of the Roof Section Identification Sheet is shown in Figure 3. A roof section plan was developed for each roof section showing all features on the roof such as perimeter conditions, rooftop equipment, projections, drains, walkways, etc. The plan was drawn on a Roof Inspection Worksheet (Figure 4).

Much of the inventory information used to complete the Roof Section Identification Sheet and develop the roof section plan was extracted from existing plans and records at the DEH office. DEH personnel were also helpful in providing basic information about the buildings. When records were incomplete, site visits to the specific buildings were required to complete the inventory. This was particularly necessary where DEH information was lacking about rooftop features such as slope, walkways, projections, etc. Core samples used in the insulating inspection were also used to verify the components of the roofing system.

Comments made by the A/E recommended that survey crews carry some drawing equipment, such as scales and plastic triangles during the visual inspections, so missing information could be added to the roof section plan or incorrect information could be modified.

INSTALLATION: FT. MEADE, MD

ROOF SECTION IDENTIFICATION			DATE FEB 10, 1987
	BLDG. NO. 4407	SECTION NO. A	AREA 7,028 SQ. FT
OCCUPANCY TELE. EXCH.		DATE ORIG. CONST. JAN 1955	DATE LAST REPL. -
10 GENERAL			
11 PERIMETER		**12 ACCESS**	
PARAPET 219 FT ROOF EDGE 167 FT		PORTABLE LADDER	
20 STRUCTURAL FRAME			
STEEL BAR JOISTS BEARING WALL			
30 ROOF DECK			
31 DESIGN LOAD		**32 TYPE**	**33 DRAINAGE**
LIVE SAFE LOAD 60 #/□' DEAD		NON-COMBUSTIBLE GYPSUM	GUTTERS & D.S.
34 SLOPE	illegible		
40 VAPOR RETARDER			
41 NONE		**42 TYPE**	
NONE		NONE	
50 INSULATION			
51 TYPE		**52 DIMENSIONS**	**54 ATTACHMENT**
FIBERBOARD		BOARD SIZE - UNKNOWN THICKNESS - 1 INCH	UNKNOWN
53 R-VALUE	2.1 ORIGINAL VALUE		
60 MEMBRANE			
61 MANUFACTURER		UNKNOWN	**62 TYPE**
SPECIFICATION NO. DESCRIPTION		UNKNOWN 9-PLY	BUILT-UP ASPHALT
63 REINFORCEMENT		**64 SURFACING**	**65 WALKWAYS**
BUR		AGGREGATE PEA GRAVEL	NONE
70 FLASHING			
71 BASE FLASHING		**72 ADHESIVE**	**74 TYPES**
MINERAL SURFACED ORGANIC		UNKNOWN	ROOF EDGE PARAPET ROOF PENETRATION PLUMBING VENT
73 COUNTER FLASHING			
METAL			

Figure 3. Completed Roof Section Identification Sheet.

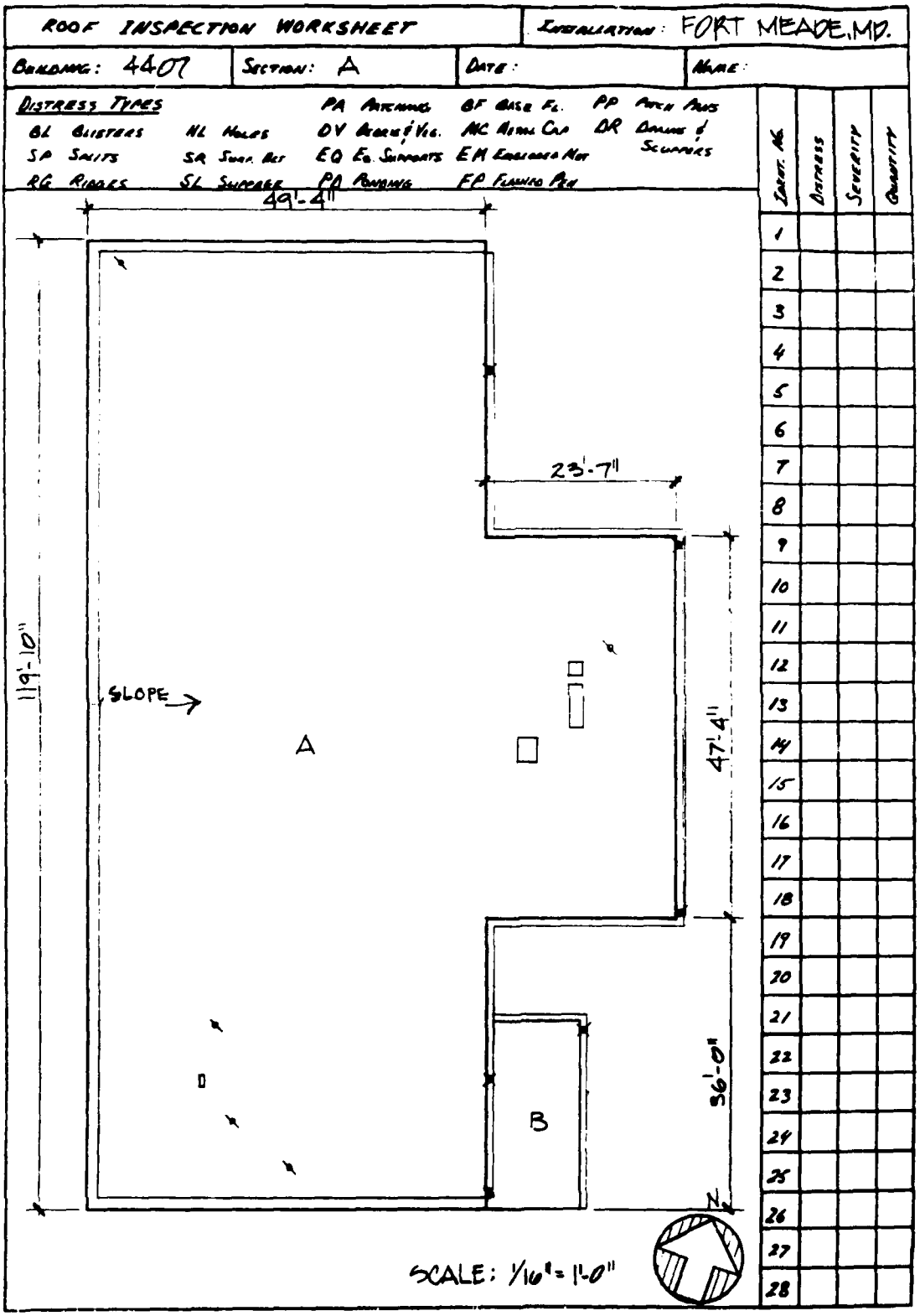

Figure 4. Roof Inspection Worksheet with roof plan.

Insulation Inspection

A complete evaluation of an insulated roofing system requires that the insulation be inspected to determine if it contains moisture. Using nondestructive moisture detection methods to determine the amount of wet insulation and knowing the moisture content of the wet areas, an insulation condition index (ICI) can be calculated for a roof section. The ICI, a numerical indicator between 0 and 100, reflects the condition of the insulation and the level of repair required. A complete description of this procedure can be found in USACERL Technical Report M-90/04.[4]

During the time the A/E was collecting the inventory information and developing the roof section plans, USAEHSC performed an aerial IR scan of the selected buildings at the three sites using helicopter mounted equipment. Before each scan, a daylight flyover was conducted to identify the buildings and to photograph the roofs using a hand-held, 35 mm camera. The IR scan was recorded on videotape and later analyzed by USAEHSC. USAEHSC provided the laboratory subcontractor with marked roof section plans indicating areas of potentially wet insulation and locations where core samples were to be taken within those areas (Figure 5).

The laboratory then cut the core samples and determined their moisture content, expressed as a percentage of the dry weight. Data were entered on the ICI Computation Sheet (Figure 6) and furnished to the A/E for final calculation.

Visual Inspection

The visual inspection procedure is a critical component of ROOFER. The distress information obtained during the visual inspection is used to calculate condition indexes for the membrane (MCI) and flashing (FCI) components of a roof section. These indexes are numerical indicators based on the same scale used for the ICI and measure the general condition and needed level of repair for the membrane and flashing components. Procedures for conducting the visual inspections are fully described in USACERL Technical Report M-87/13, Vol II.[5]

The visual inspection process was the final phase of the data collection. A/E crews used the Roof Inspection Worksheet to record the distress information while inspecting each roof section. The general approach was to first inspect the perimeter of the roof section, then all projections, curbs, etc., and finally the membrane. The A/E recommended that in addition to type, severity, and quantity of distress, the inspector should also record the defect number as listed in the distress description. This proved to be a valuable suggestion and the form was modified prior to the visual inspection at Fort Lee. Including the defect number in the data base allows the user to define repair requirements accurately and estimate their costs. Figure 7 is a typical completed Roof Inspection Worksheet for Fort Meade. The revised Roof Inspection Worksheet used at Fort Lee is shown in Figure 8.

The average inspection survey time for a two-person crew was 52 minutes per roof section. The times varied from 15 minutes to 2 hours, depending on the section area, condition of the roof, and amount and type of rooftop equipment.

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[4] D. M. Bailey, et al.

[5] M. Y. Shahin, D. M. Bailey, and D. E. Brotherson, *Membrane and Flashing Condition Indexes for Built-Up Roofs Volume II: Inspection and Distress Manual*, USACERL Technical Report M-87/13, Vol II/ADA190368 (USACERL, September 1987).

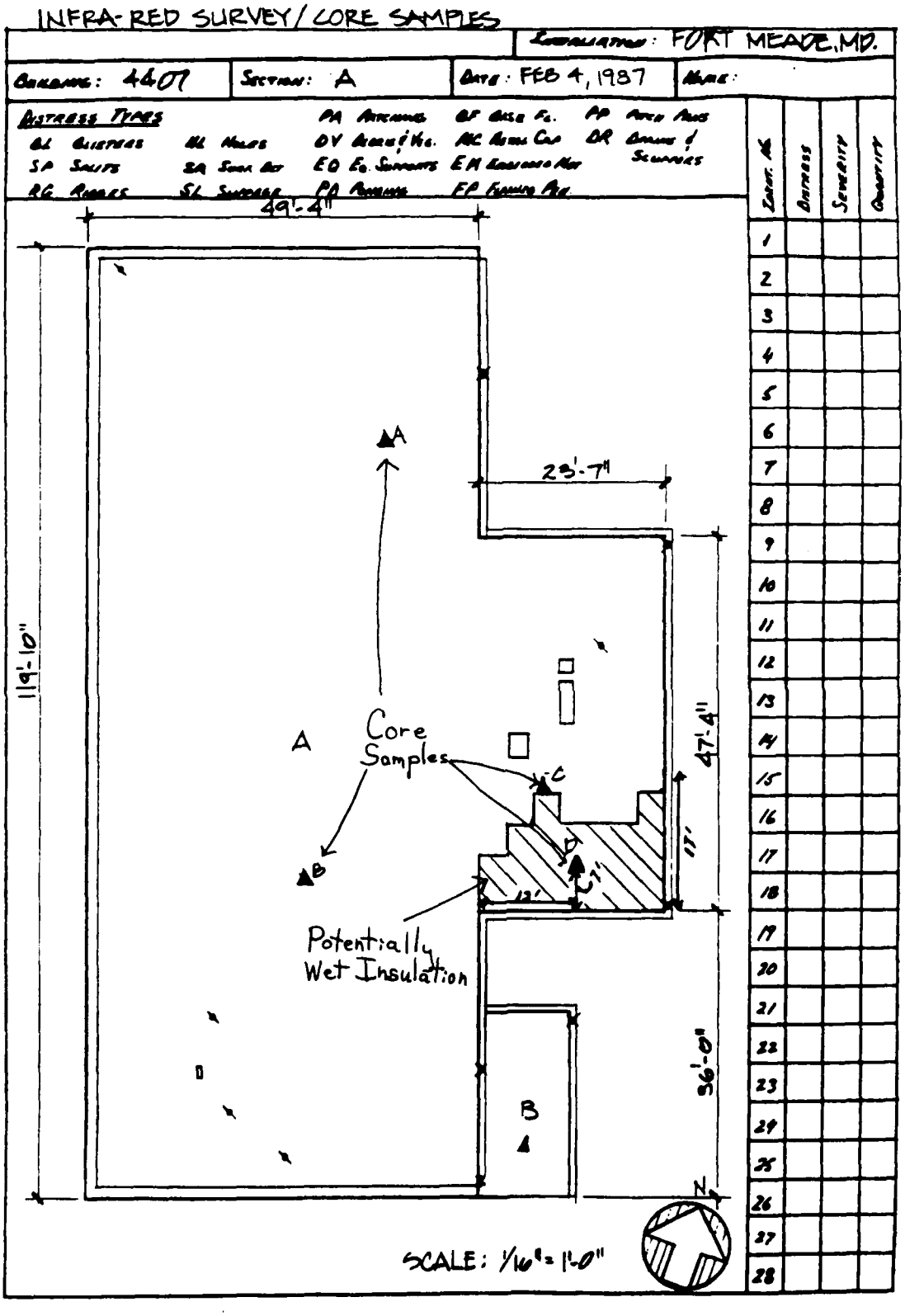


Figure 5. Roof plan marked for core samples.

COMPUTATION SHEET: INSULATION CONDITION INDEX (ICI)

Box 1

Installation FT. MEADE, MD Building 4407 Section A Area 7,028 ft^2

Moisture content calc. by SEAL ENGING Date FEB 20 19 87

ISF and ICI calcs. by _____ Date _____ 19__

CHECKED BY _____ DATE _____ 19__

I. DETERMINATION OF MOISTURE CONTENT OF CORE SAMPLES

1 Core	2 Insulation Type	3 Thickness (inch)	4 Tare (grams)	5 Wet+Tare	6 Dry+Tare	7 Wet (5-4)	8 Dry (6-4)	9 Water (7-8)	10 % Water (9÷8)x100
A	FIBERBOARD (Wood)	1				19.5	17.6	1.9	10.9
B	FIBERBOARD (Wood)	1				33.2	28.4	4.9	17.2
C	FIBERBOARD (Wood)	2				9.0	7.8	1.2	15.9
D	FIBERBOARD (Wood)	2				21.0	9.5	11.5	120.8

II. DETERMINATION OF INSULATION SEVERITY FACTOR (ISF)

1 Core	2 ISF*	3 Wet Areas **(ft^2)	4 ISF x Wet Area (2x3)
TOTALS		Box 3	Box 4

Average ISF = Box 4 ÷ Box 3 = Box 5

*Determine the ISF of each component of a composite insulation but then use only the largest ISF in the calculations.

**Do not include any areas that have an ISF of zero.

Number of wet areas 1

WAF (from table below) Box 2

No. of wet areas	WAF
1	0
2	4
3	6
4	8
more than 4	10

III. DETERMINATION OF INSULATION CONDITION INDEX (ICI)

Problem Density = (Wet Area ÷ Total Area)100

= (Box 3 ÷ Box 1)100 = Box 6 %

From Figure 3, IDV = Box 7

ICI = 100 - (IDV + WAF)ISF = 100 - (Box 7 + Box 2)(Box 5)

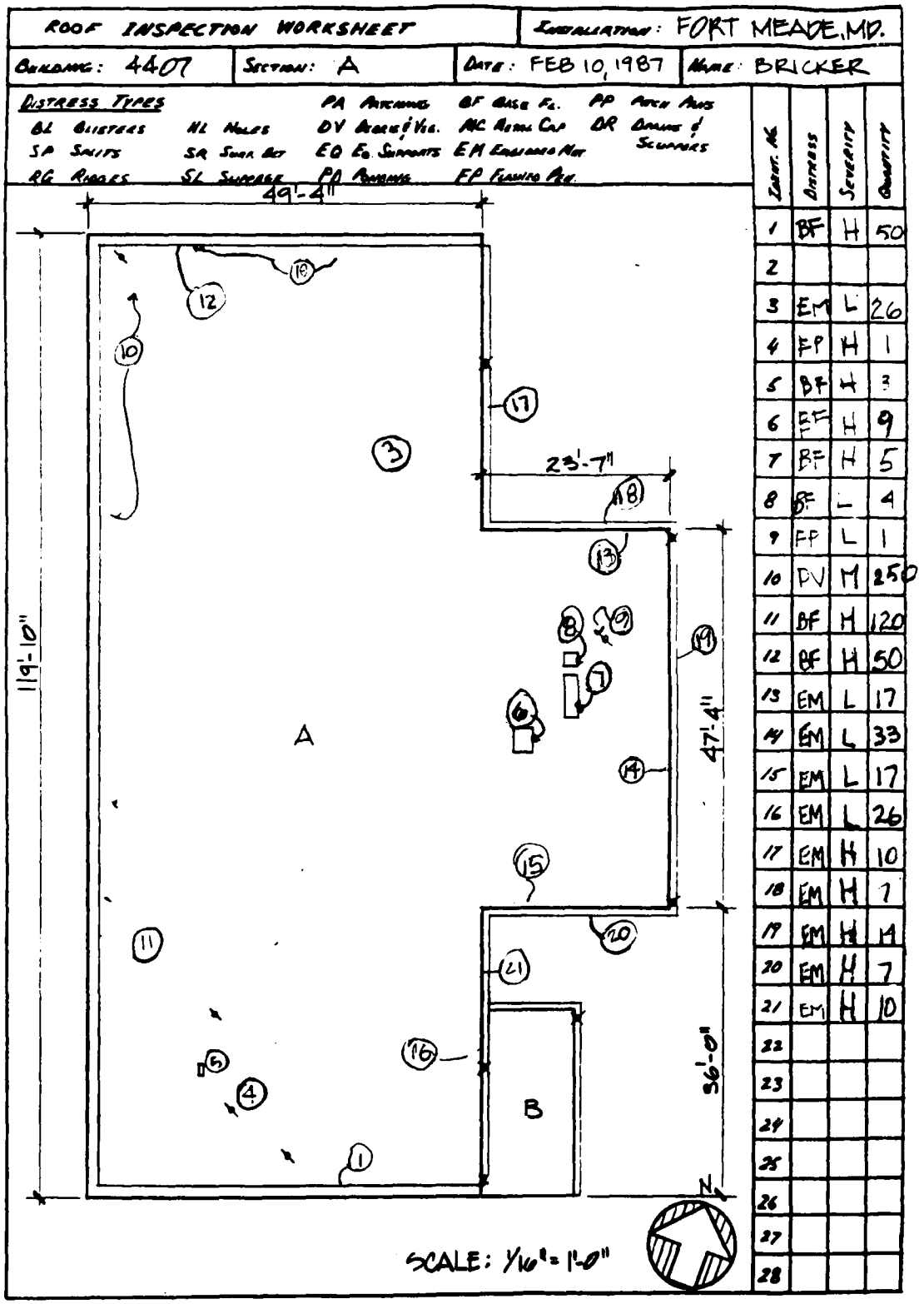
ICI = 100 - (____ + ____) (____) = *** = ICI

RATING (from table at right)

***Round to nearest whole number

ICI	RATING
0-10	Failed
11-25	Very Poor
26-40	Poor
41-55	Fair
56-70	Good
71-85	Very Good
86-100	Excellent

Figure 6. ICI Computation Sheet.



Sheet No.	Distress	Severity	Quantity
1	BF	H	50
2			
3	EM	L	26
4	FP	H	1
5	BF	H	3
6	BF	H	9
7	BF	H	5
8	BF	L	4
9	FP	L	1
10	PV	M	250
11	BF	H	120
12	BF	H	50
13	EM	L	17
14	EM	L	33
15	EM	L	17
16	EM	L	26
17	EM	H	10
18	EM	H	7
19	EM	H	14
20	EM	H	7
21	EM	H	10
22			
23			
24			
25			
26			
27			
28			

Figure 7. Completed Roof Inspection Worksheet.

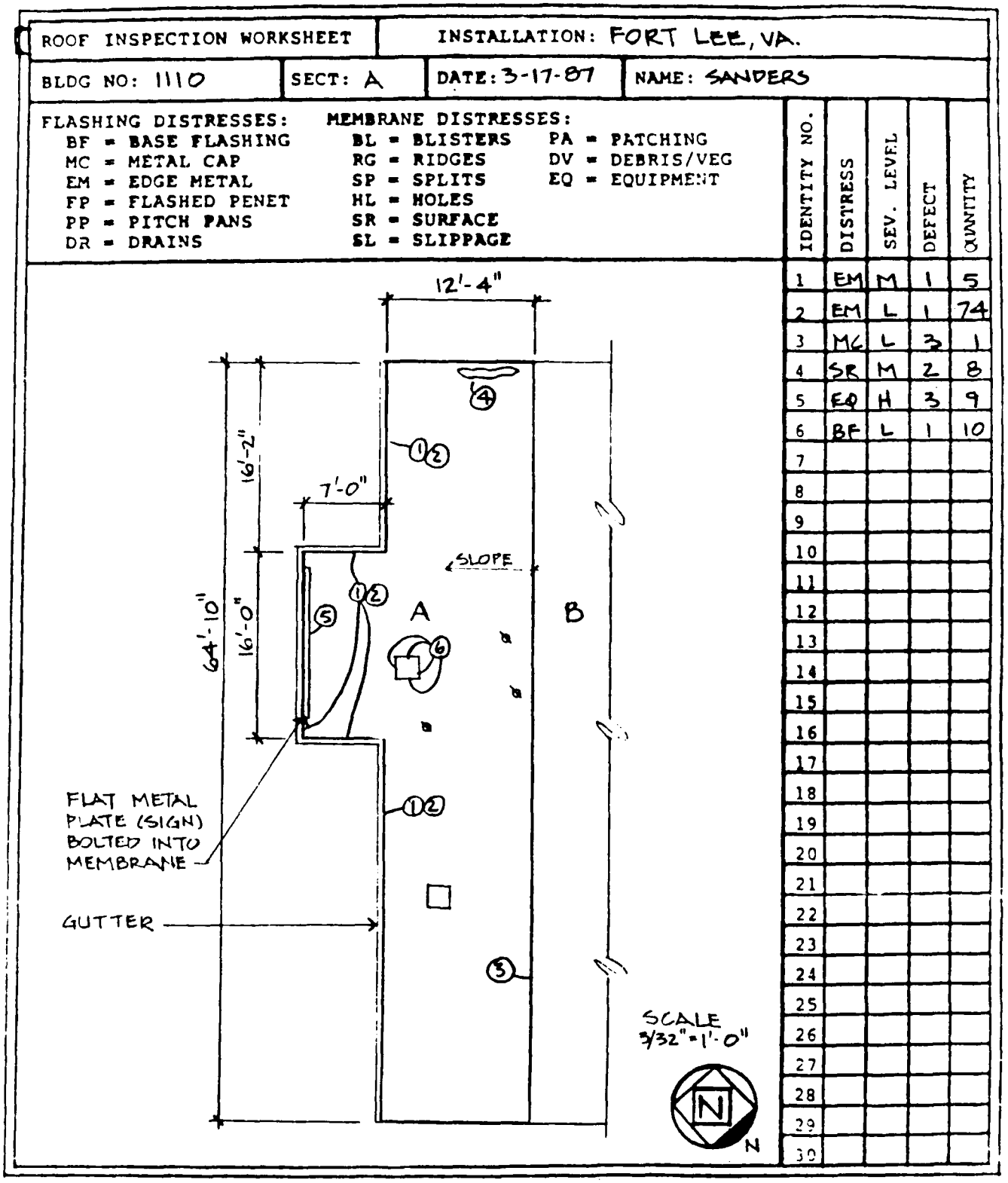


Figure 8. Revised Roof Inspection Worksheet - Fort Lee.

In-Process Review

The A/E was instructed to perform the data collection on five buildings (15 roof sections) at Fort Meade to allow for an in-process review before proceeding with the balance of the buildings included in the FEAP project. After the preliminary work was completed, the A/E submitted the data to USACERL for review and evaluation. The project team cross-checked the inventory data, roof plans, and inspection sheets, and recalculated the condition indexes to verify the A/E's work. A meeting was then conducted at Fort Meade with the A/E to complete the review and discuss suggested changes to the forms and procedures. The project team also inspected several of the roof sections to substantiate the accuracy of the work. When the review was completed, the A/E was allowed to proceed with the 38 remaining buildings.

3 DATA PROCESSING AND MANAGEMENT

The data processing and management phase of the demonstration included performing the calculations of the individual component condition indexes and the overall roof condition index, putting the collected inventory and inspection information into organized files, and generating management reports from the collected information. To achieve this, it was necessary to store data in a usable manner by either a manual recordkeeping system or an automated computer system. A manual system was first used for this function; a microcomputer application, which was being developed during the time of the demonstration, was also used.

Manual System

The actual computation of the individual component condition indexes was performed by the A/E. The A/E calculated the distress densities and deduct values for each roof section by using an internally developed application of a commercial spreadsheet and the deduct value curve equations provided by USACERL. This information was summarized on the Roof Section Rating Form to calculate the FCI and MCI (Figure 9). The ICI was computed by completing the Insulation Condition Index Computation Sheet (Figure 10). The RCI was calculated from these three indexes using the RCI Calculation Sheet (Figure 11).

The A/E indicated that the spreadsheet application was not cost effective, but commented that if the calculations could be performed by a user-friendly computer program, considerable savings in time and cost could be realized.

The completed inventory, inspection, and calculation sheets were sent to USACERL where the project team organized the information in a folder format. A building folder containing the Building Identification Sheet and the Building Identification Plan was established for each project building. A roof section folder containing a Roof Section Identification Sheet, a master Roof Inspection Worksheet (with unmarked roof section plan), and all completed inspection and calculation sheets was established for each individual roof section.

Once the project team established the manual recordkeeping system for each of the three sites, the information was manipulated through use of a microcomputer to generate management reports. The inventory and inspection data were entered into a spreadsheet using a tabular format and through the use of a data base utility, three summary reports were generated: Building Inventory, RCI, and RCI distribution. (See Appendixes A, B, C for Fort Meade, Fort Lee, and New Cumberland Army Depot, respectively).

The Building Inventory Report provided a list of the project buildings and general information for each of the surveyed roof sections. (Figure 12 shows a partial listing.) The RCI report listed the three individual component condition indexes, the RCI, and overall condition rating for each roof section (Figure 13 shows a partial listing). The RCI Distribution Report presented a graphical plot of the frequency of occurrences within the different RCI ranges (Figure 14).

ROOF SECTION RATING FORM

DATE:

INSTALLATION: FT. MEADE, MD | BUILDING: 4407 | SECTION: A

PERIMETER FL. 386 FT. | FLASHING TOTAL: 424 FT | AREA: 7,023 SQ FT.
CURB FL. 38 FT.

FLASHING

DISTRESS TYPES

- BF BASE FLASHING
- MC METAL CAP FL.
- EM EMBEDDED METAL
- FP FLASHED PEN.
- PP PITCH PANS
- DR DRAINS & SCUPPERS

TYPE	SEV	QUANTITIES	TOTAL	DENS.	DV
BF	H	[illegible]	237	55.9	75
BF	L	4	4	0.94	3
EM	L	119	119	28.1	14
EM	H	48	48	11.3	36
FP	L	1	1	0.24	3
FP	H	1	1	0.24	12

DEDUCT TOTAL #: 6 — 143

CORRECTED DEDUCT VALUE (CDV) — 75

FCI = 100 − CDV = 25

RATING = VERY POOR

MEMBRANE

DISTRESS TYPES

- BL BLISTERS
- SP SPLITS
- RG RIDGES
- HL HOLES
- SR SURFACE DET.
- SL SLIPPAGE
- PA PATCHING
- DV DEBRIS & VEG.
- EQ EQUIP. SUPPORTS
- PD PONDING

TYPE	SEV.	QUANTITIES	TOTAL	DENS.	DV
DV	M	250	250	3.6	4

DEDUCT TOTAL #: 1 — 4

CORRECTED DEDUCT VALUE (CDV) — 4

MCI = 100 − CDV = 96

RATING = EXCELLENT

CALCULATED BY DAVID HAMMES DATE MAR 6, 1987
CHECKED BY SCOTT SANDERS DATE 23 APR. 1987

Figure 9. Completed Roof Section Rating Form.

ICI CALCULATION SHEET	INSTALLATION FT. MEADE		
DATE 2/20/87	BLDG NO 4407	SECTION ID A	AREA 7028 SQFT
MOIST CONT CALC. BY SEAL ENGIN'G		ISF & ICI CALC. BY DAVID HAMMES	

1. DETERMINATION OF MOISTURE CONTENT OF CORE SAMPLES

CORE	INSULATION TYPE	THICK. INCH	A TARE GRAM	B WET+ TARE	C DRY+ TARE	D WET B-A	E DRY C-A	F WATER D-E	%WATER F/E
A	FIBER BOARD	1"				19.5	17.6	1.9	10.9
B	FIBER BOARD	1"				33.2	28.4	4.9	17.2
C	FIBER BOARD	2"				9.0	7.8	1.2	15.9
D	FIBER BOARD	2"				21.0	9.5	11.5	120.8

2. DETERMINATION OF AVERAGE ISF

CORE	ISF (A)	WET AREA (B)	(A) X (B)
A	0.29	NONE	—
B	0.50	NONE	—
C	0.47	NONE	—
D	0.93	270	251
TOTALS		(C) 270	(D) 251
AVERAGE ISF (D)/(C)			(E) 0.93

3. DETERMINATION OF ICI

PROBLEM DENSITY: 3.8
[TOTAL WET AREA / TOTAL AREA X 100]

IDV (FROM FIG 3): 40

WAF: 0 (FROM TABLE BELOW)

ICI: 37
[100 - (IDV + WAF) X AVERAGE ISF]

RATING: POOR

1. DETERMINE THE ISF FOR EACH COMPONENT OF COMPOSITE INSULATION; USE THE LARGEST ISF IN THE CALCULATIONS.
2. DO NOT INCLUDE ANY AREAS THAT HAVE AN ISF OF ZERO.
3. ROUND RATING TO NEAREST WHOLE NUMBER.

DETERMINATION OF WAF

NO. WET AREAS	WAF
1	0
2	4
3	6
4	8
>4	10

INSULATION CONDITION RATING

NUMERICAL	DESCRIPTION
86 - 100	EXCELLENT
71 - 85	VERY GOOD
56 - 70	GOOD
41 - 55	FAIR
26 - 40	POOR
11 - 25	VERY POOR
1 - 10	FAILED

Figure 10. Completed ICI Computation Sheet.

RCI · CALCULATION SHEET	INSTALLATION	FT. MEADE	
DATE - 2/20/07	BLDG NO 4407	SECTION ID A	AREA 7028 SQ FT

	VALUE	LOWEST	OTHER
MCI	96		96
PCI	25	25	
ICI	37		37
	TOTAL	(A) 25	(B) 133
		X 0.70	X 0.15
	VALUE	(C) 17.5	(D) 20.0
		(C) + (D)	37.5

RATING: REPLACEMENT PROBABLE

RATING SCALE	
86 - 100	ROUTINE MAINTENANCE ONLY
71 - 85	MINOR REPAIRS NEEDED
56 - 70	MODERATE REPAIRS NEEDED
41 - 55	MAJOR REPAIRS NEEDED
26 - 40	REPLACEMENT PROBABLE
11 - 25	REPLACEMENT NEEDED
1 - 10	REPLACEMENT CRITICAL

Figure 11. Completed RCI Calculation Sheet.

BUILDING INVENTORY REPORT
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

BUILDING NUMBER	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQFT
38	WAREHOUSE	A	BUR-PITCH	NONE	WOODBOARD	2	11189
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	FIBERBOARD	STEEL	1/4	4072
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	876
82		B	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	1300
82		C	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	1641
82		D	BUR-ASPHALT	NONE	PLYWOOD	1/8	364
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	162
85		B	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	13529
85		C	BUR-ASPHALT	POLYURETHANE	STEEL	1/4	5588
85		D	BUR-ASPHALT	POLYURETHANE	STEEL	1/4	7875
85		E	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	162
393	CAREER CENTER	A	BUR-ASPHALT	GLASS FIBER	STEEL	1/2	10368
1251	US ARMY RESERVE	A	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/2	1915
1251		B	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/2	5223
1251		C	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/2	4446
1251		D	BUR-ASPHALT	FIBERB'D,PERL.,URETH.	STEEL	1/2	9601
2239	CONSOL MESS HALL	A	BUR-ASPHALT	NONE	PLYWOOD	1/4	5152
2239		B	BUR-ASPHALT	NONE	PLYWOOD	1/2	9270
2239		C	BUR-ASPHALT	NONE	PLYWOOD	1/2	2334
2239		D	BUR-ASPHALT	NONE	PLYWOOD	1/2	5263
2786	COMMISSARY	A	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	24156
2791	POST EXCHANGE	A	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	3492
2791		B	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	3330
2791		C	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	2620
2791		D	BUR-ASPHALT	PERLITE,POLYURETHANE	STEEL	1/4	2697
2791		E	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	1620
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	FIBERBOARD	GYPSUM	1/8	7028
4407		B	BUR-ASPHALT	PERLITE	CONCRETE	1/8	258
4550	HEADQUARTERS	A	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	8359
4550		B	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	2277
4550		C	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	8903

Figure 12. Example Building Inventory Report.

RCI REPORT
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

BUILDING NUMBER	NAME	SECTION ID	MEMBRANE TYPE	AREA SQFT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
38	WAREHOUSE	A	BUR-PITCH	11189		3/87	26	37	100	30	POOR
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	4072		3/87	76	92	100	82	VERY GOOD
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	876	7/61	3/87	72	95	100	80	VERY GOOD
82	FIRE & RESCUE STATION	B	BUR-ASPHALT	1300	7/61	3/87	77	99	100	84	VERY GOOD
82	FIRE & RESCUE STATION	C	BUR-ASPHALT	1641	7/61	3/87	66	96	52	61	GOOD
82	FIRE & RESCUE STATION	D	BUR-ASPHALT	364	7/61	3/87	81	100	100	87	EXCELLENT
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	162	1/72	3/87	71	55	100	64	GOOD
85	AIRCRAFT HANGAR & MAINTENANCE	B	BUR-ASPHALT	13529	1/72	3/87	67	80	100	74	VERY GOOD
85	AIRCRAFT HANGAR & MAINTENANCE	C	BUR-ASPHALT	5508	1/72	3/87	69	95	100	78	VERY GOOD
85	AIRCRAFT HANGAR & MAINTENANCE	D	BUR-ASPHALT	7875	1/72	3/87	69	80	100	75	VERY GOOD
85	AIRCRAFT HANGAR & MAINTENANCE	E	BUR-ASPHALT	162	1/72	3/87	75	88	100	81	VERY GOOD
393	CAREER CENTER	A	BUR-ASPHALT	10368		3/87	62	77	100	70	VERY GOOD
1251	US ARMY RESERVE	A	BUR-ASPHALT	1915	9/76	3/87	66	92	100	75	VERY GOOD
1251	US ARMY RESERVE	B	BUR-ASPHALT	5223	9/76	3/87	82	72	100	78	VERY GOOD
1251	US ARMY RESERVE	C	BUR-ASPHALT	4446	9/76	3/87	91	60	100	71	VERY GOOD
1251	US ARMY RESERVE	D	BUR-ASPHALT	9601	9/76	3/87	55	76	27	39	POOR
2239	CONSOL MESS HALL	A	BUR-ASPHALT	5152		3/87	65	38	100	51	FAIR
2239	CONSOL MESS HALL	B	BUR-ASPHALT	9270		3/87	45	35	100	46	FAIR
2239	CONSOL MESS HALL	C	BUR-ASPHALT	2334		3/87	42	60	100	53	FAIR
2239	CONSOL MESS HALL	D	BUR-ASPHALT	5263		3/87	50	55	100	58	GOOD
2786	COMMISSARY	A	BUR-ASPHALT	24156	2/85	3/87	75	98	100	82	VERY GOOD
2791	POST EXCHANGE	A	BUR-ASPHALT	3492	5/75	3/87	81	96	100	86	EXCELLENT
2791	POST EXCHANGE	B	BUR-ASPHALT	3330	5/75	3/87	55	87	100	67	GOOD
2791	POST EXCHANGE	C	BUR-ASPHALT	2620	5/75	3/87	72	92	100	79	VERY GOOD
2791	POST EXCHANGE	D	BUR-ASPHALT	2697	5/75	3/87	80	96	100	85	EXCELLENT
2791	POST EXCHANGE	E	BUR-ASPHALT	1620	5/75	3/87	64	96	100	74	VERY GOOD
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	7028	1/55	3/87	25	96	37	38	POOR
4407	TELEPHONE EXCHANGE	B	BUR-ASPHALT	258	1/55	3/87	72	94	100	80	VERY GOOD
4550	HEADQUARTERS	A	BUR-UNKNOWN	8359	3/79	3/87	40	86	100	56	GOOD
4550	HEADQUARTERS	B	BUR-UNKNOWN	2277	3/79	3/87	65	86	100	73	VERY GOOD
4550	HEADQUARTERS	C	BUR-UNKNOWN	8903	3/79	3/87	50	87	100	63	GOOD

Figure 13. Example RCI Report.

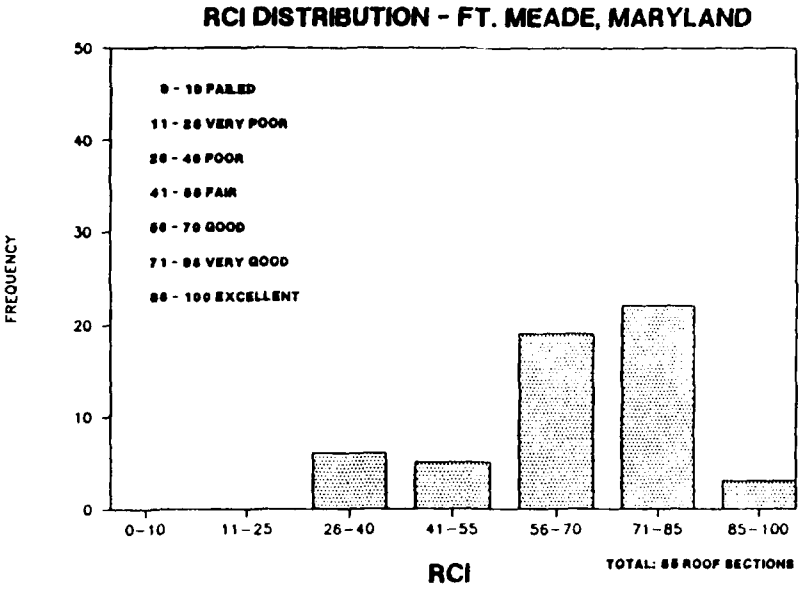


Figure 14. Example RCI Distribution Report.

Members of the project team analyzed the inspection data and generated repair requirements for individual roof sections. Repair statements for each of the medium and high severity distresses were developed and entered into the same spreadsheet data base. For each roof section recommended for repair, based on the subjective evaluation of the team, a Corrective Action Report (Figure 15) was generated detailing the necessary repair tasks which could be cross-referenced with the Roof Inspection Worksheet.

A proposed Five-Year Plan, showing priorities for scheduling the recommended repair projects, was also developed (included in each Appendix). This plan was based on the premise that good roofs needing some repairs should receive first priority to preserve valuable assets. Marginal roofs should be repaired if funds are available and poor roofs should be allowed to continue to deteriorate with only emergency or temporary repairs until replacement is accomplished. Figure 16 is an example of this report.

Most of the effort for this phase of the work was spent developing the spreadsheet application and inputting information into the data base. Once this was done, generating each of the reports required very little time.

Microcomputer System

When the FEAP project was initiated, the microcomputer application of the system (Micro ROOFER[6]) was in its early stages of development. The program was in the testing stages when the data from this demonstration project was being analyzed using manual methods making it very convenient to use this data to run a comparison test.

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[6] D. E. Bailey, B. Young, and D. E. Brotherson, *Micro ROOFER User's Guide*, USACERL ADP Report M-90/12 (USACERL, April 1990).

The microcomputer system offers some distinct advantages in data management over a manual system. Micro ROOFER allows the collected data to be entered into the program using a series of screens that use the same terminology and format as the inventory and inspection sheets. When the data has been entered, the program will calculate the indexes and generate several reports. Micro ROOFER provides improved information retrieval capabilities, ease of modifying and recalculating data, and unlimited data storage.

The collected data from the three installations was input by the project team into Micro ROOFER. Average input time was less than 30 minutes per roof section. The manual system took an average of about 40 minutes per roof section. This included time to assimilate the inventory and inspection sheets, perform the calculations, and establish building and roof section files (Table 2). The computer generated inventory and condition indexes were checked by comparing them against the manually generated reports. Only minor discrepancies were found and then corrected.

The report generation capability offered tremendous time savings when summarizing and presenting the information from the data base. Micro ROOFER can generate customized reports "at the push of a button."

```
FT. MEADE, MARYLAND
********************************************************************************
BUILDING:85

NAME:     AIRCRAFT HANGAR & MAINTENANCE

SECTION: B      AREA:13529 SQFT          DECK: STEEL          INSULATION: PERLITE,
                                                                          POLYURETHANE

                                         SLOPE: 1/4IN12       MEMBRANE: BUR-ASPHALT

                FCI = 67                 MCI =80              ICI = 100

                                    *****RCI =73.9 *****

********************************************************************************

                                  CORRECTIVE ACTIONS


QUANTITY UNIT  REFERENCE     REPAIR
      22   FT  9-12          REPLACE BASE FLASHING
      80   FT  2,4,6,8       RENAIL AND RESTRIP EMBEDDED EDGE METAL
       5   EA  13,15-18      FILL PITCH PAN AND PAINT
       3   EA  2,3,5         REPAIR HOLES
      35 SQFT  1             REPAIR MEMBRANE; REPLACE WITH SIMILAR MATERIAL
       1 SQFT  4             REMOVE FOREIGN MATERIALS FROM ROOF
```

Figure 15. Example Corrective Actions Report.

FIVE YEAR M & R PLAN
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

BUILDING NUMBER	NAME	SECT ID	MEMBRANE TYPE	AREA SQFT	MAINT ONLY	REPLACE YEAR	REPAIR YEAR
38	WAREHOUSE	A	BUR-PITCH	11189		1	
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	4072	X		
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	876	X		
82	FIRE & RESCUE STATION	B	BUR-ASPHALT	1300	X		
82	FIRE & RESCUE STATION	C	BUR-ASPHALT	1641			1
82	FIRE & RESCUE STATION	D	BUR-ASPHALT	364	X		
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	162			1
85	AIRCRAFT HANGAR & MAINTENANCE	B	BUR-ASPHALT	13529			1
85	AIRCRAFT HANGAR & MAINTENANCE	C	BUR-ASPHALT	5588			1
85	AIRCRAFT HANGAR & MAINTENANCE	D	BUR-ASPHALT	7875			1
85	AIRCRAFT HANGAR & MAINTENANCE	E	BUR-ASPHALT	162	X		
393	CAREER CENTER	A	BUR-ASPHALT	10368			1
1251	US ARMY RESERVE	A	BUR-ASPHALT	1915			1
1251	US ARMY RESERVE	B	BUR-ASPHALT	5223			1
1251	US ARMY RESERVE	C	BUR-ASPHALT	4446		5	
1251	US ARMY RESERVE	D	BUR-ASPHALT	9601		1	
2239	CONSOL MESS HALL	A	BUR-ASPHALT	5152		2	
2239	CONSOL MESS HALL	B	BUR-ASPHALT	9270		2	
2239	CONSOL MESS HALL	C	BUR-ASPHALT	2334		2	
2239	CONSOL MESS HALL	D	BUR-ASPHALT	5263		2	
2786	COMMISSARY	A	BUR-ASPHALT	24156	X		
2791	POST EXCHANGE	A	BUR-ASPHALT	3492	X		
2791	POST EXCHANGE	B	BUR-ASPHALT	3330		4	
2791	POST EXCHANGE	C	BUR-ASPHALT	2620	X		
2791	POST EXCHANGE	D	BUR-ASPHALT	2697	X		
2791	POST EXCHANGE	E	BUR-ASPHALT	1620			1
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	7028		1	
4407	TELEPHONE EXCHANGE	B	BUR-ASPHALT	258	X		
4550	HEADQUARTERS	A	BUR-UNKNOWN	8359			1
4550	HEADQUARTERS	B	BUR-UNKNOWN	2277			1
4550	HEADQUARTERS	C	BUR-UNKNOWN	8903			1

Figure 16. Example Five-Year Plan for MRR.

Table 2

System Procedure Times

Manual System*

Fort	# of buildings	# of sections	time
Lee	14	61	40 man-hours
Meade	20	55	36
New Cumberland	9	31	21

Microcomputer System**

Fort	# of buildings	# of sections	time
Lee	14	61	30 man-hours
Meade	20	55	26
New Cumberland	9	31	15

*Includes assimilating inventory and inspection worksheets, performing calculations, and developing building and section files.

**Includes assimilating inventory and inspection worksheets, inputting information into the microcomputer, and generating calculations.

4 SYSTEM TURNOVER TO INSTALLATION PERSONNEL

Once completed, the data base files, including the building and roof section folders and the reports, were given to the DEH personnel at each of the installations. The system turnover included:

1. A presentation of the ROOFER program with an explanation of the information contained in the system folders. The project team described the data collection procedures, the methods used to calculate the indexes, the significance of the indexes, and the use of the various forms.

2. A complete discussion of the roof distresses, including a review of each of the photographs shown in USACERL Technical Report M-87/13, Vol II.[7]

3. A presentation of the visual inspection procedure for built-up roofs, including discussion of necessary tools and techniques for conducting the inspection and completing the Roof Inspection Worksheet.

4. A followup "on-the-roof" visual inspection where the procedures were demonstrated and questions from the DEH personnel could be discussed and answered. The on-the-roof experience usually generated a series of questions by the DEH personnel. These included questions about current problems, inspection of roofing application, and repair methods for problems on existing roofs.

5. A presentation of the recommended repairs for each of the roof sections and a Five-Year Plan for the repair and replacement of project roofs.

6. A preview of the Micro ROOFER computer program and its capabilities.

The system turnover phase left the DEH with the start of a management program for their built-up roofs.

[7]M. Y. Shahin, D. M. Bailey, and D. E. Brotherson.

5 CONCLUSIONS

The FEAP demonstration at Fort Meade, Fort Lee, and New Cumberland Army Depot was a successful implementation of the ROOFER program. The A/E comments were especially useful and several changes were made to the forms and techniques used in ROOFER.

The ROOFER methodology of evaluating membrane, flashing, and insulation separately provides an ideal base to generate repair and replacement recommendations. The RCI, which combines the three indexes, provides the information needed for effective network management.

The Micro ROOFER application will reduce the amount of time and effort needed to process the collected data and produce management reports.

After evaluating the demonstrations at these three installations, the ROOFER system was judged ready for implementation. USACERL has released Micro ROOFER (Version 1.0) and established a Strategic Support Center for the system. USAEHSC is responsible for providing assistance for implementing and maintaining the ROOFER program at the installation and MACOM level within the Army.

APPENDIX A:

REPORTS FOR FORT MEADE, MD

BUILDING INVENTORY REPORT
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

BLDG #	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQ FT
38	WAREHOUSE	A	BUR-PITCH	NONE	WOODBOARD	2	11189
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	FIBERBOARD	STEEL	1/4	4072
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	876
82		B	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	1300
82		C	BUR-ASPHALT	FIBERBOARD	STEEL	1/2	1641
82		D	BUR-ASPHALT	NONE	PLYWOOD	1/8	364
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	162
85		B	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	13529
85		C	BUR-ASPHALT	POLYURETHANE	STEEL	1/4	5588
85		D	BUR-ASPHALT	POLYURETHANE	STEEL	1/4	7875
85		E	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	162
393	CAREER CENTER	A	BUR-ASPHALT	GLASS FIBER	STEEL	1/2	10368
1251	US ARMY RESERVE	A	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/2	1915
1251		B	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/2	5223
1251		C	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/2	4446
1251		D	BUR-ASPHALT	FIBERB'D, PERL., URETH.	STEEL	1/2	9601
2239	CONSOL MESS HALL	A	BUR-ASPHALT	NONE	PLYWOOD	1/4	5152
2239		B	BUR-ASPHALT	NONE	PLYWOOD	1/2	9270
2239		C	BUR-ASPHALT	NONE	PLYWOOD	1/2	2334
2239	CONSOL MESS HALL	D	BUR-ASPHALT	NONE	PLYWOOD	1/2	5263
2786	COMMISSARY	A	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	24156
2791	POST EXCHANGE	A	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	3492
2791		B	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	3330
2791		C	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	2620
2791		D	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	2697
2791		E	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	1620
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	FIBERBOARD	GYPSUM	1/8	7028
4407		B	BUR-ASPHALT	PERLITE	CONCRETE	1/8	258
4550	HEADQUARTERS	A	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	8359
4550		B	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	2277
4550		C	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	8903
4550		D	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	677
4550		E	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	1717
4550		F	BUR-UNKNOWN	POLYISOCYANURATE	CONCRETE	UK	8359
4550		G	BUR-UNKNOWN	NONE	CONCRETE	UK	111

BLDG #	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQ FT
4707	BRETT	A	BUR-COALTAR	LIGHTWEIGHT CONCRETE	CONCRETE	1/8	7360
4707		B	BUR-COALTAR	LIGHTWEIGHT CONCRETE	CONCRETE	1/8	970
6330	GAFFNEY SPORTS ARENA	A	BUR-ASPHALT	GLASS FIBER	STEEL	1/2	15959
6330		B	BUR-ASPHALT	GLASS FIBER	STEEL	1/2	10149
6330		C	BUR-ASPHALT	GLASS FIBER	CONCRETE	1/2	8720
6600	OFFICER'S CLUB	A	BUR-ASPHALT	PERLITE, POLYURETHANE	STEEL	1/4	22800
6600		B	BUR-UNKNOWN	UNKNOWN	STEEL	1/8	2003
8465	CAVALRY CHAPEL	A	BUR-ASPHALT	FIBERBOARD	WOODBOARD	2	5319
8465		B	BUR-ASPHALT	FIBERBOARD	WOODBOARD	2	2798
8465		C	BUR-ASPHALT	NONE	WOODBOARD	1/8	1349
8478	ENLISTED MEN'S BARRACKS	A	BUR-ASPHALT	LIGHTWEIGHT CONCRETE	CONCRETE	1/8	10374
8478		B	BUR-ASPHALT	LIGHTWEIGHT CONCRETE	CONCRETE	1/8	5195
8501	REGIMENTAL HEADQUARTERS	A	BUR-UNKNOWN	FIBERBOARD	CONCRETE	1/2	3100
8542	H.Q. - BATTALION	A	BUR-UNKNOWN	GLASS FIBER	CONCRETE	UK	2720
9804	MARINE BARRACKS	A	BUR-UNKNOWN	INSUL. FILL - GYPSUM	CONCRETE	1/8	5655
9804		B	BUR-UNKNOWN	INSUL. FILL - GYPSUM	CONCRETE	1/8	5655
9804		C	BUR-UNKNOWN	INSUL. FILL - GYPSUM	CONCRETE	UK	7398
9804		D	BUR-UNKNOWN	FIBERBOARD	CONCRETE	UK	5655
9804		E	BUR-UNKNOWN	FIBERBOARD	CONCRETE	UK	5655
9829	FOUR HATS	A	BUR-ASPHALT	GLASS FIBER	STEEL	1/2	16495

RCI REPORT
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

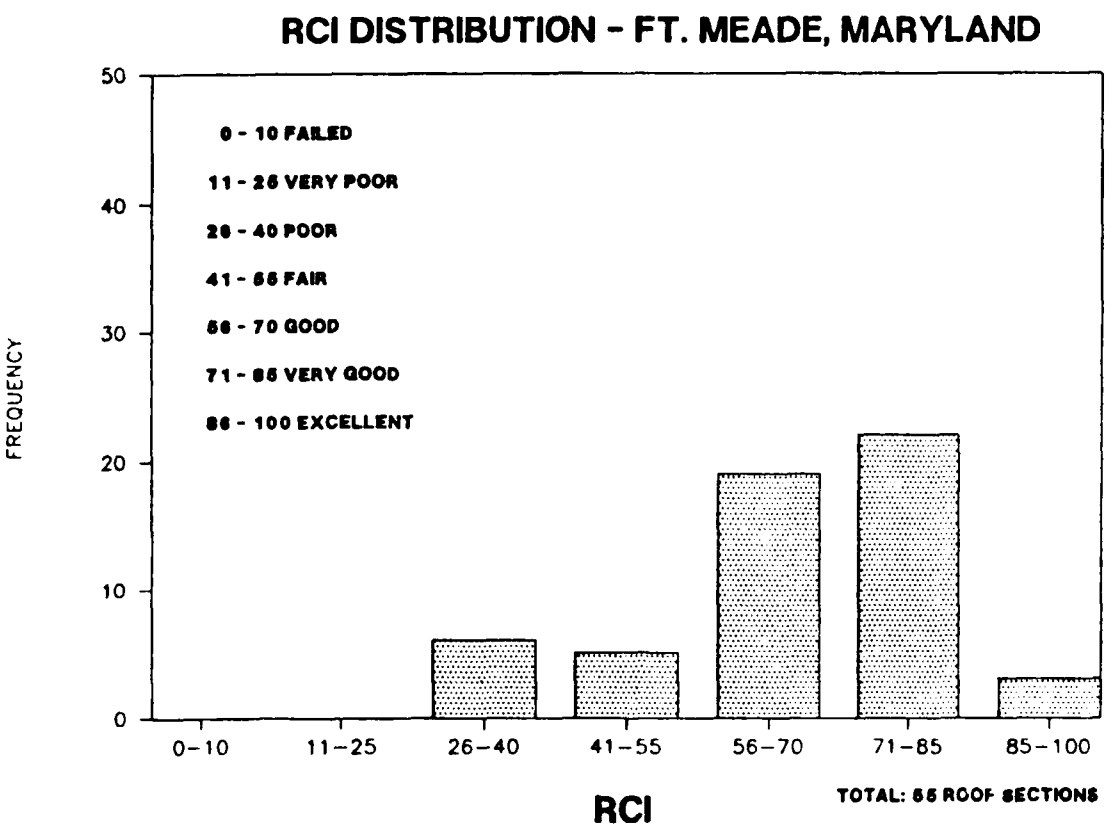
BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
38	WAREHOUSE	A	BUR-PITCH	11189		3/87	26	37	100	39	POOR
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	4072		3/87	76	92	100	82	VERY GOOD
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	876	7/61	3/87	72	95	100	80	VERY GOOD
82		B	BUR-ASPHALT	1300	7/61	3/87	77	99	100	84	VERY GOOD
82		C	BUR-ASPHALT	1641	7/61	3/87	66	96	52	61	GOOD
82		D	BUR-ASPHALT	364	7/61	3/87	81	100	100	87	EXCELLENT
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	162	1/72	3/87	71	55	100	64	GOOD
85		B	BUR-ASPHALT	13529	1/72	3/87	67	80	100	74	VERY GOOD
85		C	BUR-ASPHALT	5588	1/72	3/87	69	95	100	78	VERY GOOD
85		D	BUR-ASPHALT	7875	1/72	3/87	69	80	100	75	VERY GOOD
85		E	BUR-ASPHALT	162	1/72	3/87	75	88	100	81	VERY GOOD
393	CAREER CENTER	A	BUR-ASPHALT	10368		3/87	62	77	100	70	VERY GOOD
1251	US ARMY RESERVE	A	BUR-ASPHALT	1915	9/76	3/87	66	92	100	75	VERY GOOD
1251		B	BUR-ASPHALT	5223	9/76	3/87	82	72	100	78	VERY GOOD
1251		C	BUR-ASPHALT	4446	9/76	3/87	91	60	100	71	VERY GOOD
1251		D	BUR-ASPHALT	9601	9/76	3/87	55	76	27	39	POOR
2239	CONSOL MESS HALL	A	BUR-ASPHALT	5152		3/87	65	38	100	51	FAIR
2239		B	BUR-ASPHALT	9270		3/87	45	35	100	46	FAIR
2239		C	BUR-ASPHALT	2334		3/87	42	60	100	53	FAIR
2239		D	BUR-ASPHALT	5263		3/87	50	55	100	58	GOOD
2786	COMMISSARY	A	BUR-ASPHALT	24156	2/85	3/87	75	98	100	82	VERY GOOD
2791	POST EXCHANGE	A	BUR-ASPHALT	3492	5/75	3/87	81	96	100	86	EXCELLENT
2791		B	BUR-ASPHALT	3330	5/75	3/87	55	87	100	67	GOOD
2791		C	BUR-ASPHALT	2620	5/75	3/87	72	92	100	79	VERY GOOD
2791		D	BUR-ASPHALT	2697	5/75	3/87	80	96	100	85	EXCELLENT
2791		E	BUR-ASPHALT	1620	5/75	3/87	64	96	100	74	VERY GOOD
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	7028	1/55	3/87	25	96	37	38	POOR
4407		B	BUR-ASPHALT	258	1/55	3/87	72	94	100	80	VERY GOOD
4550	HEADQUARTERS	A	BUR-UNKNOWN	8359	3/79	3/87	40	86	100	56	GOOD
4550		B	BUR-UNKNOWN	2277	3/79	3/87	65	86	100	73	VERY GOOD
4550		C	BUR-UNKNOWN	8903	3/79	3/87	50	87	100	63	GOOD
4550		D	BUR-UNKNOWN	677	3/79	3/87	56	88	100	67	GOOD
4550		E	BUR-UNKNOWN	1717	3/79	3/87	68	82	100	75	VERY GOOD
4550		F	BUR-UNKNOWN	8359	3/79	3/87	61	79	100	70	VERY GOOD
4550		G	BUR-UNKNOWN	111	3/79	3/87	83	71	100	77	VERY GOOD

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
4707	BRETT	A	BUR-COAL TAR	7360	12/54	3/87	59	80	100	68	GOOD
4707		B	BUR-COAL TAR	970	12/54	3/87	44	72	100	57	GOOD
6330	GAFFNEY SPORTS ARENA	A	BUR-ASPHALT	15959	5/73	3/87	62	66	100	68	GOOD
6330		B	BUR-ASPHALT	10149	5/73	3/87	46	75	100	59	GOOD
6330		C	BUR-ASPHALT	8720	5/73	3/87	58	82	100	68	GOOD
6600	OFFICER'S CLUB	A	BUR-ASPHALT	22800	2/82	3/87	76	96	100	83	VERY GOOD
6600		B	BUR-UNKNOWN	2003	2/82	3/87	90	70	100	78	VERY GOOD
8465	CAVALRY CHAPEL	A	BUR-ASPHALT	5319	3/62	3/87	66	94	100	75	VERY GOOD
8465		B	BUR-ASPHALT	2798	3/62	3/87	58	85	55	60	GOOD
8465		C	BUR-ASPHALT	1349	3/62	3/87	77	86	100	82	VERY GOOD
8478	ENLISTED MEN'S BARRACKS	A	BUR-ASPHALT	10374	11/55	3/87	71	88	100	78	VERY GOOD
8478		B	BUR-ASPHALT	5195	11/55	3/87	61	79	12	29	POOR
8501	REGIMENTAL HEADQUARTERS	A	BUR-UNKNOWN	3100	10/61	3/87	82	61	26.5	40	FAIR
8542	H.Q. - BATTALION	A	BUR-UNKNOWN	2720	/55	3/87	37	68	100	51	FAIR
9804	MARINE BARRACKS	A	BUR-UNKNOWN	5655	12/55	3/87	65	63	100	69	GOOD
9804		B	BUR-UNKNOWN	5655	12/55	3/87	69	55	100	64	GOOD
9804		C	BUR-UNKNOWN	7398	12/55	3/87	58	90	100	69	GOOD
9804		D	BUR-UNKNOWN	5655	9/68	3/87	68	58	10	26	POOR
9804		E	BUR-UNKNOWN	5655	9/68	3/87	70	59	9	26	POOR
9829	FOUR HATS	A	BUR-ASPHALT	16495	11/72	3/87	53	65	100	62	GOOD

FIVE YEAR M & R PLAN
DATE: MARCH 15, 1987
FT. MEADE, MARYLAND

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	MAINT ONLY	REPLACE YEAR	REPAIR YEAR
38	WAREHOUSE	A	BUR-PITCH	11189		1	
68	MOTOR MAINTENANCE FACILITY	A	BUR-UNKNOWN	4072	X		
82	FIRE & RESCUE STATION	A	BUR-ASPHALT	876	X		
82		B	BUR-ASPHALT	1300	X		
82		C	BUR-ASPHALT	1641			1
82		D	BUR-ASPHALT	364	X		
85	AIRCRAFT HANGAR & MAINTENANCE	A	BUR-ASPHALT	162			1
85		B	BUR-ASPHALT	13529			1
85		C	BUR-ASPHALT	5588			1
85		D	BUR-ASPHALT	7875			1
85		E	BUR-ASPHALT	162	X		
393	CAREER CENTER	A	BUR-ASPHALT	10368			1
1251	US ARMY RESERVE	A	BUR-ASPHALT	1915			1
1251		B	BUR-ASPHALT	5223			1
1251		C	BUR-ASPHALT	4446		5	
1251		D	BUR-ASPHALT	9601		1	
2239	CONSOL MESS HALL	A	BUR-ASPHALT	5152		2	
2239		B	BUR-ASPHALT	9270		2	
2239		C	BUR-ASPHALT	2334		2	
2239		D	BUR-ASPHALT	5263		2	
2786	COMMISSARY	A	BUR-ASPHALT	24156	X		
2791	POST EXCHANGE	A	BUR-ASPHALT	3492	X		
2791		B	BUR-ASPHALT	3330		4	
2791		C	BUR-ASPHALT	2620	X		
2791		D	BUR-ASPHALT	2697	X		
2791		E	BUR-ASPHALT	1620			1
4407	TELEPHONE EXCHANGE	A	BUR-ASPHALT	7028		1	
4407		B	BUR-ASPHALT	258	X		
4550	HEADQUARTERS	A	BUR-UNKNOWN	8359			1
4550		B	BUR-UNKNOWN	2277			1
4550		C	BUR-UNKNOWN	8903			1
4550		D	BUR-UNKNOWN	677			1
4550		E	BUR-UNKNOWN	1717			1
4550		F	BUR-UNKNOWN	8359			1
4550		G	BUR-UNKNOWN	111			1

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	MAINT ONLY	REPLACE YEAR	REPAIR YEAR
4707	BRETT	A	BUR-COAL TAR	7360	5		
4707		B	BUR-COAL TAR	970	5		
6330	GAFFNEY SPORTS ARENA	A	BUR-ASPHALT	15959			2
6330		B	BUR-ASPHALT	10149			2
6330		C	BUR-ASPHALT	8720			2
6600	OFFICER'S CLUB	A	BUR-ASPHALT	22800	X		
6600		B	BUR-UNKNOWN	2003			1
8465	CAVALRY CHAPEL	A	BUR-ASPHALT	5319			1
8465		B	BUR-ASPHALT	2798			1
8465		C	BUR-ASPHALT	1349	X		
8478	ENLISTED MEN'S BARRACKS	A	BUR-ASPHALT	10374			1
8478		B	BUR-ASPHALT	5195		1	
8501	REGIMENTAL HEADQUARTERS	A	BUR-UNKNOWN	3100		1	
8542	H.Q. - BATTALION	A	BUR-UNKNOWN	2720		2	
9804	MARINE BARRACKS	A	BUR-UNKNOWN	5655			1
9804		B	BUR-UNKNOWN	5655			1
9804	MARINE BARRACKS CAFETERIA	C	BUR-UNKNOWN	7398			1
9804	MARINE BARRACKS	D	BUR-UNKNOWN	5655		1	
9804		E	BUR-UNKNOWN	5655		1	
9829	FOUR HATS	A	BUR-ASPHALT	16495			1


RCI DISTRIBUTION - FT. MEADE, MARYLAND
0 - 10 FAILED
11 - 25 VERY POOR
26 - 40 POOR
41 - 55 FAIR
56 - 70 GOOD
71 - 85 VERY GOOD
86 - 100 EXCELLENT
FREQUENCY
50
40
30
20
10
0
0-10
11-25
26-40
41-55
56-70
71-85
85-100
RCI
TOTAL: 55 ROOF SECTIONS

APPENDIX B:

REPORTS FOR FORT LEE, VA

BUILDING INVENTORY REPORT
DATE: MARCH 15, 1987
FT. LEE, VIRGINIA

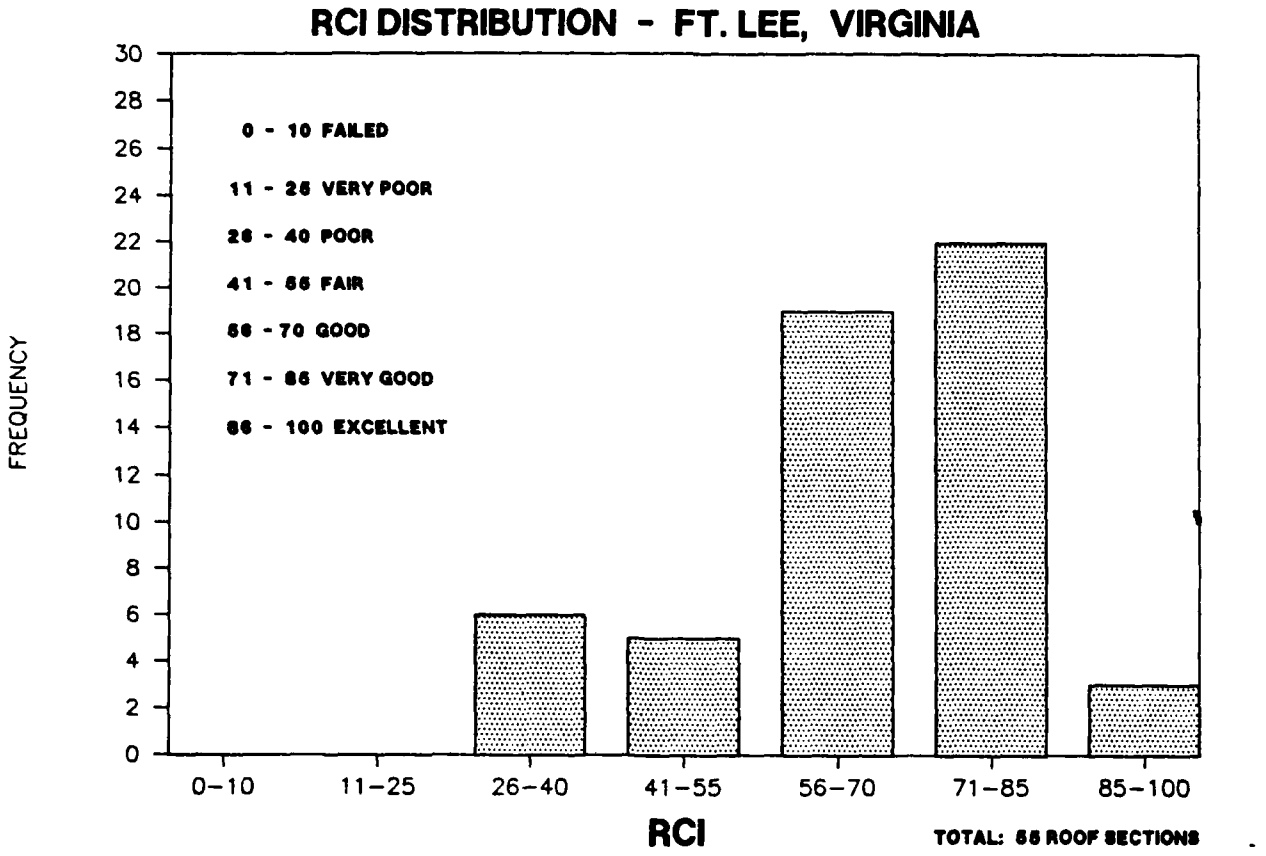
BLDG #	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQ FT
1110	DINING HALL - AIRMEN	A	BUR-ASPHALT	GYPSUM	GYPSUM	3/8	911
1110		B	BUR-ASPHALT	GYPSUM	GYPSUM	3/8	2417
1110		C	BUR-ASPHALT	GYPSUM	GYPSUM	3/8	631
2609	OPEN DINING FACILITY	A	BUR-ASPHALT	GYPSUM	GYPSUM	1	4332
2609		B	BUR-ASPHALT	FIBERBOARD	PLYWOOD	1/4	4916
2609		C	BUR-ASPHALT	GYPSUM	GYPSUM	1/8	3258
2609		D	BUR-ASPHALT	GYPSUM	GYPSUM	1/8	2313
2609		E	BUR-ASPHALT	GYPSUM	GYPSUM	1/8	3902
2609		F	BUR-ASPHALT	GYPSUM	GYPSUM	1/8	1818
4229	UNMARRIED OFFICER'S	A	BUR-ASPHALT	POLYURETHANE	L.W. CONCRETE	1/2	5453
4229		B	BUR-ASPHALT	POLYURETHANE	L.W. CONCRETE	1/2	3916
4229		C	BUR-ASPHALT	POLYURETHANE	L.W. CONCRETE	1/2	170
4229		D	BUR-ASPHALT	POLYURETHANE	L.W. CONCRETE	1/2	957
4300	POST THEATER	A	BUR-ASPHALT	NONE	CONCRETE	1/8	2872
4300		B	BUR-ASPHALT	NONE	CONCRETE	1/8	10784
4300		C	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	581
4300		D	BUR-ASPHALT	NONE	CONCRETE	1/8	1466
4300		E	BUR-ASPHALT	NONE	CONCRETE	1/8	1433
4320	PHYSICAL FITNESS CEN	A	BUR-ASPHALT	PERLITE, POLY	STEEL	1/4	10155
4320		B	BUR-ASPHALT	PERLITE, POLY	STEEL	1/4	20038
4320	PHYSICAL FITNESS CEN	C	BUR-ASPHALT	PERLITE, POLY	STEEL	1/4	7434
4320		D	BUR-ASPHALT	PERLITE, POLY	STEEL	1/4	11095
5000	MIFSLIN HALL	A	BUR-ASPHALT	POLYISO	STEEL	1/8	8315
5000		B	BUR-ASPHALT	POLYISO	CONCRETE	1/8	16025
5000		C	BUR-ASPHALT	POLYISO	CONCRETE	1/8	9867
5000		D	BUR-ASPHALT	POLYISO	CONCRETE	1/8	7103
5000		E	BUR-ASPHALT	POLYISO	CONCRETE	1/8	3171
5000		F	BUR-ASPHALT	POLYISO	CONCRETE	1/8	1481
5000		G	BUR-ASPHALT	POLYISO	CONCRETE	1/8	1224
5000		H	BUR-ASPHALT	POLYISO	CONCRETE	1/8	9426
6250	SMALL ARMS STORAGE A	A	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/4	7134

BLDG #	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQ FT
7118	COLD STORAGE FACILITY	A	BUR-ASPHALT	NONE	WOOD BOARDS	1/4	6523
7118		B	BUR-ASPHALT	NONE	CONCRETE	1/8	7979
7118		C	BUR-ASPHALT	FIBERBOARD	CONCRETE	1/8	7861
7118		D	BUR-COAL TAR	GLASS FIBER	WOOD BOARDS	1/8	6596
8130	KENNER ARMY HOSPITAL	A	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	6619
8130		B	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	3562
8130		C	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	3686
8130		D	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	1761
8130		E	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	242
8130		F	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	4872
8130		G	BUR-ASPHALT	PERLITE, POLY	STEEL	1/4	962
8130		H	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	4316
8130		I	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	1927
8130		J	BUR-ASPHALT	L.W. CONCRETE	CONCRETE	1/8	9363
8130		K	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	13014
8130		L	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	11774
8130		M	BUR-ASPHALT	GLASS FIBER	STEEL	1/4	16607
8150	E. W. BARRACKS	A	BUR-ASPHALT	GLASS FIBER	CONCRETE	1/8	1963
8150		B	BUR-ASPHALT	GLASS FIBER	CONCRETE	1/8	4108
8151	E. W. BARRACKS ADMIN. A	A	BUR-ASPHALT	GLASS FIBER	CONCRETE	1/8	5240
8402	BARRACKS	A	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	13674
8402		B	BUR-ASPHALT	POLYURETHANE	CONCRETE	1/8	12801
8402		C	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	13674
9035	CRAFTS SHOP	A	BUR-ASPHALT	EXTR POLYSTY	STEEL	1/2	8828
9035		B	BUR-ASPHALT	EXTR POLYSTY	STEEL	1/2	8657
12400	US ARMY LOGISTICS	A	BUR-COAL TAR	GLASS FIBER	CONCRETE	1/8	4696
12400		B	BUR-COAL TAR	GLASS FIBER	CONCRETE	1/8	5208
12400		C	BUR-COAL TAR	GLASS FIBER	CONCRETE	1/8	4672
12400		D	BUR-ASPHALT	POLYISO	CONCRETE	1/8	1886
12400		E	BUR-ASPHALT	POLYISO	CONCRETE	1/8	2048

RCI REPORT
DATE: MARCH 15, 1987
FT. LEE, VIRGINIA

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
1110	DINING HALL - AIRMEN	A	BUR-ASPHALT	911	1957	3/87	79	70	100	76	VERY GOOD
1110		B	BUR-ASPHALT	2417		3/87	75	88	100	81	VERY GOOD
1110		C	BUR-ASPHALT	631		3/87	73	100	100	81	VERY GOOD
2609	OPEN DINING FACILITY	A	BUR-ASPHALT	4332	1955	3/87	73	99	100	81	VERY GOOD
2609		B	BUR-ASPHALT	4916		3/87	65	93	100	74	VERY GOOD
2609		C	BUR-ASPHALT	3258		3/87	74	100	100	82	VERY GOOD
2609		D	BUR-ASPHALT	2313		3/87	62	89	100	72	VERY GOOD
2609		E	BUR-ASPHALT	3902		3/87	68	93	100	77	VERY GOOD
2609		F	BUR-ASPHALT	1818		3/87	68	96	100	77	VERY GOOD
4229	UNMARRIED OFFICER'S	A	BUR-ASPHALT	5453	1972	3/87	65	96	100	75	VERY GOOD
4229		B	BUR-ASPHALT	3916		3/87	70	98	100	79	VERY GOOD
4229		C	BUR-ASPHALT	170		3/87	63	94	100	73	VERY GOOD
4229		D	BUR-ASPHALT	957		3/87	56	93	100	68	GOOD
4300	POST THEATER	A	BUR-ASPHALT	2872	1947	3/87	68	93	100	77	VERY GOOD
4300		B	BUR-ASPHALT	10784		3/87	68	90	100	76	VERY GOOD
4300		C	BUR-ASPHALT	581		3/87	75	75	100	79	VERY GOOD
4300		D	BUR-ASPHALT	1466		3/87	52	79	100	63	GOOD
4300		E	BUR-ASPHALT	1433		3/87	67	68	100	72	VERY GOOD
4320	PHYSICAL FITNESS CEN	A	BUR-ASPHALT	10155	1982	3/87	85	91	100	88	EXCELLENT
4320		B	BUR-ASPHALT	20038		3/87	53	93	100	66	GOOD
4320		C	BUR-ASPHALT	7434		3/87	80	87	100	84	VERY GOOD
4320		D	BUR-ASPHALT	11095		3/87	82	92	100	86	EXCELLENT
5000	MIFSLIN HALL	A	BUR-ASPHALT	8315	1959	3/87	90	72	100	7	VERY GOOD
5000		B	BUR-ASPHALT	16025		3/87	71	93	100	79	VERY GOOD
5000	MIFSLIN HALL	C	BUR-ASPHALT	9867		3/87	71	94	100	79	VERY GOOD
5000		D	BUR-ASPHALT	7103		3/87	65	93	100	74	VERY GOOD
5000		E	BUR-ASPHALT	3171		3/87	74	100	100	82	VERY GOOD
5000		F	BUR-ASPHALT	1481		3/87	61	100	100	73	VERY GOOD
5000		G	BUR-ASPHALT	1224		3/87	76	95	100	82	VERY GOOD
5000		H	BUR-ASPHALT	9426		3/87	72	92	100	79	VERY GOOD
6250	SMALL ARMS STORAGE A	A	BUR-ASPHALT	7134	1978	3/87	72	95	100	80	VERY GOOD
7118	COLD STORAGE FACILITY	A	BUR-ASPHALT	6523	1952	3/87	64	95	100	74	VERY GOOD
7118		B	BUR-ASPHALT	7979	1941	3/87	52	97	100	66	GOOD
7118		C	BUR-ASPHALT	7861		3/87	60	97	100	72	VERY GOOD
7118		D	BUR-COAL TAR	6596		3/87	71	59	100	67	GOOD

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
8130	KENNER ARMY HOSPITAL	A	BUR-ASPHALT	6619	1962	3/87	60	91	100	71	VERY GOOD
8130		B	BUR-ASPHALT	3562		3/87	40	100	100	58	GOOD
8130		C	BUR-ASPHALT	3686		3/87	68	100	100	78	VERY GOOD
8130		D	BUR-ASPHALT	1761		3/87	49	87	100	62	GOOD
8130		E	BUR-ASPHALT	242		3/87	65	100	100	76	VERY GOOD
8130		F	BUR-ASPHALT	4872		3/87	64	98	100	75	VERY GOOD
8130		G	BUR-ASPHALT	962		3/87	80	96	100	85	EXCELLENT
8130		H	BUR-ASPHALT	4316		3/87	49	82	100	62	GOOD
8130		I	BUR-ASPHALT	1927		3/87	50	9	100	29	POOR
8130		J	BUR-ASPHALT	9363		3/87	53	87	100	65	GOOD
8130		K	BUR-ASPHALT	13014		3/87	31	97	100	51	FAIR
8130		L	BUR-ASPHALT	11774		3/87	44	100	100	61	GOOD
8130		M	BUR-ASPHALT	16607		3/87	38	99	100	56	GOOD
8150	E. W. BARRACKS	A	BUR-ASPHALT	1963	1974	3/87	68	91	100	76	VERY GOOD
8150		B	BUR-ASPHALT	4108		3/87	66	95	100	75	VERY GOOD
8151	E. W. BARRACKS ADMIN. A	A	BUR-ASPHALT	5240	1974	3/87	70	80	5	26	POOR
8402	BARRACKS	A	BUR-ASPHALT	13674	1948	3/87	75	94	100	82	VERY GOOD
8402		B	BUR-ASPHALT	12801		3/87	68	78	100	74	VERY GOOD
8402		C	BUR-ASPHALT	13674		3/87	70	93	100	78	VERY GOOD
9035	CRAFTS SHOP	A	BUR-ASPHALT	8828	1965	3/87	69	93	100	77	VERY GOOD
9035	CRAFTS SHOP	B	BUR-ASPHALT	8657		3/87	67	100	100	77	VERY GOOD
12400	US ARMY LOGISTICS	A	BUR-COAL TAR	4696	1956	3/87	28	64	27	33	POOR
12400		B	BUR-COAL TAR	5208		3/87	0	71	7	12	VERY POOR
12400		C	BUR-COAL TAR	4672		3/87	30	79	10	23	VERY POOR
12400		D	BUR-ASPHALT	1886		3/87	67	95	100	76	VERY GOOD
12400		E	BUR-ASPHALT	2048		3/87	56	56	100	63	GOOD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28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 - 10 FAILED
11 - 25 VERY POOR
26 - 40 POOR
41 - 55 FAIR
56 - 70 GOOD
71 - 85 VERY GOOD
86 - 100 EXCELLENT
0-10
11-25
26-40
41-55
56-70
71-85
85-100
RCI
TOTAL: 55 ROOF SECTIONS

FIVE YEAR M & R PLAN
DATE: MARCH 15, 1987
FT. LEE, VIRGINIA

	MAINTAIN	REPAIR	REPLACE
YEAR ONE	1110 B C	1110 A	8130 I
		2609 B D	8151 A
	2609 A C	E	12400 A B
	5000 E G	5000 A B C	C
	8130 G	D F	
	8402 A B	H	
	C	9035 A B	
YEAR ONE ALTERNATE		8130 A - M	
YEAR TWO		4229 A B C D	
		4300 A B C D E	
		4320 A B C D E	
		7118 A B C D	
		8150 A B	
YEAR THREE		6250 A	
YEAR FOUR	NONE		
YEAR FIVE			8130 A-H

APPENDIX C:

REPORTS FOR NEW CUMBERLAND ARMY DEPOT, PA

INVENTORY REPORT
DATE: MARCH 15, 1987
NEW CUMBERLAND, PA

BLDG #	NAME	SECT ID	MEMBRANE TYPE	INSULATION TYPE	DECK TYPE	SLOPE IN 12	AREA SQ FT
1	WAREHOUSE	A	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		B	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		C	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		D	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		E	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		F	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		G	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		H	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
1		I	BUR-ASPHALT	PERLITE	WOOD BOARDS	1/8	22218
21	WAREHOUSE	A	BUR-ASPHALT	PERLITE	CONCRETE	1/8	29000
54		A	BUR-ASPHALT	FIBERBOARD	WOOD BOARDS	1/8	44905
54		B	BUR-ASPHALT	FIBERBOARD	WOOD BOARDS	1/8	44905
54		C	BUR-ASPHALT	FIBERBOARD	WOOD BOARDS	1/8	22400
54		D	BUR-ASPHALT	FIBERBOARD	WOOD BOARDS	1/8	44905
54		E	BUR-ASPHALT	FIBERBOARD	WOOD BOARDS	1/8	44905
81	HEADQUARTERS	A	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	11981
81		B	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	11981
85	WAREHOUSE	A	BUR-ASPHALT	GLASS FIBER	STEEL	1/8	40000
85		B	BUR-ASPHALT	GLASS FIBER	STEEL	1/8	40000
85		C	BUR-ASPHALT	GLASS FIBER	STEEL	1/8	40000
85		D	BUR-ASPHALT	GLASS FIBER	STEEL	1/8	40000
85		E	BUR-ASPHALT	GLASS FIBER	STEEL	1/8	40000
351	NURSERY	A	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	4200
351		B	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	1050
351		C	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	4200
351		D	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	825
400	BARRACKS	A	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	10108
400		B	BUR-ASPHALT	PERLITE, POLY	CONCRETE	1/8	5633
406	STORE	A	BUR-ASPHALT	FIBERBOARD	STEEL	1/8	1937
411	SERVICE STATION	A	BUR-ASPHALT	FIBERBOARD	CONCRETE	1/8	1300
411		B	BUR-ASPHALT	FIBERBOARD	CONCRETE	1/8	950

RCI REPORT
DATE: MARCH 15, 1987
NEW CUMBERLAND, PA

BLDG #	NAME	SECT ID	MEMBRANE TYPE	AREA SQ FT	DATE CONST	DATE INSPEC	FCI	MCI	ICI	RCI	RATING
1	WAREHOUSE	A	BUR-ASPHALT	22218		3/87	55	90	100	67	GOOD
1		B	BUR-ASPHALT	22218		3/87	62	88	38	49	FAIR
1		C	BUR-ASPHALT	22218		3/87	68	79	40	50	FAIR
1		D	BUR-ASPHALT	22218		3/87	63	91	43	53	FAIR
1		E	BUR-ASPHALT	22218		3/87	76	92	100	82	VERY GOOD
1		F	BUR-ASPHALT	22218		3/87	79	93	38	52	FAIR
1		G	BUR-ASPHALT	22218		3/87	72	88	100	79	VERY GOOD
1		H	BUR-ASPHALT	22218		3/87	72	92	29	45	FAIR
1		I	BUR-ASPHALT	22218		3/87	56	75	70	61	GOOD
21	WAREHOUSE	A	BUR-ASPHALT	29000		3/87	56	38	50	43	FAIR
54	WAREHOUSE	A	BUR-ASPHALT	44905		3/87	60	85	100	70	GOOD
54		B	BUR-ASPHALT	44905		3/87	72	88	100	79	VERY GOOD
54		C	BUR-ASPHALT	22400		3/87	57	91	100	69	GOOD
54	WAREHOUSE	D	BUR-ASPHALT	44905		3/87	78	88	100	83	VERY GOOD
54		E	BUR-ASPHALT	44905		3/87	73	91	100	80	VERY GOOD
81	HEADQUARTERS	A	BUR-ASPHALT	11981		3/87	73	91	100	79	VERY GOOD
81	HEADQUARTERS	B	BUR-ASPHALT	11981		3/87	73	84	100	79	VERY GOOD
85	WAREHOUSE	A	BUR-ASPHALT	40000		3/87	72	92	100	79	VERY GOOD
85		B	BUR-ASPHALT	40000		3/87	60	89	100	70	VERY GOOD
85		C	BUR-ASPHALT	40000		3/87	70	87	100	77	VERY GOOD
85		D	BUR-ASPHALT	40000		3/87	66	88	100	74	VERY GOOD
85		E	BUR-ASPHALT	40000		3/87	64	88	100	73	VERY GOOD
351	NURSERY	A	BUR-ASPHALT	4200		3/87	78	72	100	77	VERY GOOD
351	NURSERY	B	BUR-ASPHALT	1050		3/87	70	87	100	77	VERY GOOD
351		C	BUR-ASPHALT	4200		3/87	73	94	100	80	VERY GOOD
351		D	BUR-ASPHALT	825		3/87	73	87	100	79	VERY GOOD
400	BARRACKS	A	BUR-ASPHALT	10100		3/87	71	89	59	65	GOOD
400		B	BUR-ASPHALT	5633		3/87	63	89	100	73	VERY GOOD
406	STORE	A	BUR-ASPHALT	1937		3/87	75	75	100	79	VERY GOOD
411	SERVICE STATION	A	BUR-ASPHALT	1300		3/87	55	72	100	64	GOOD
411		B	BUR-ASPHALT	950		3/87	56	81	100	66	GOOD

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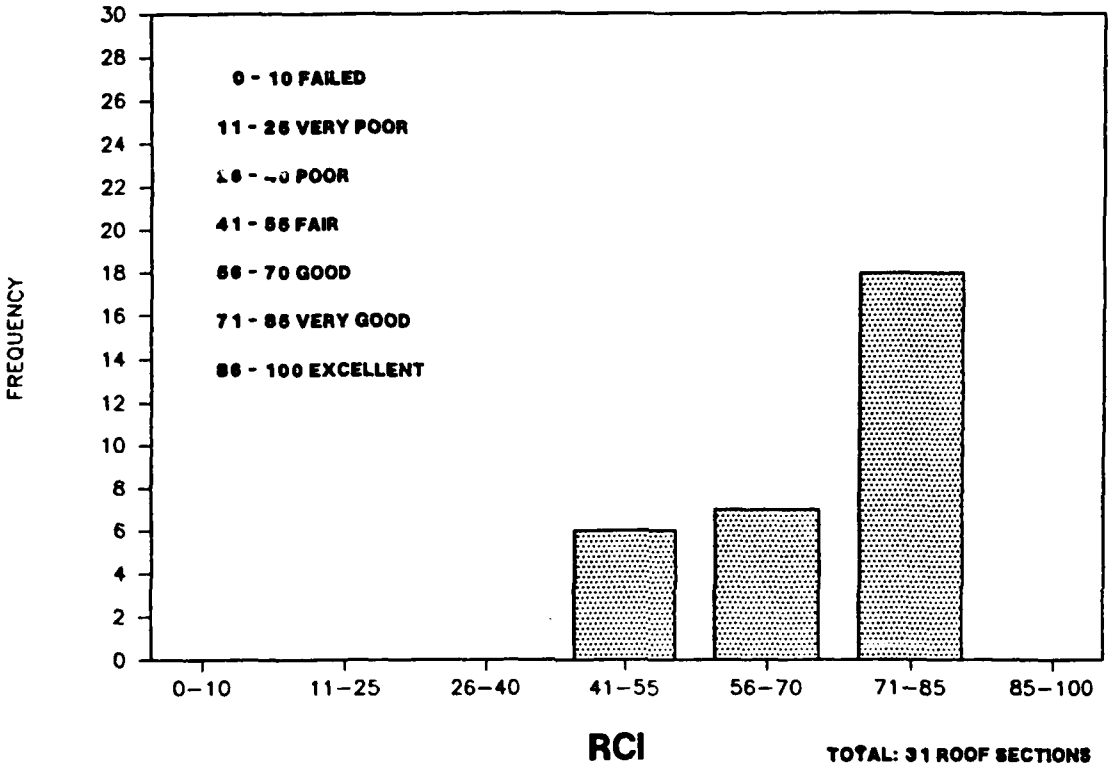

FIVE YEAR M & R PLAN
DATE: MARCH 15, 1987
NEW CUMBERLAND, PA

	REPAIR	REPLACE
YEAR ONE	1 G	1 B
	1 A	21 A
	54 E	
	54 B	
	85 A	
	85 C	
	85 D	
	81 A	
YEAR TWO	81 B	
	85 E	
	54 A	
	400 B	
	351 C	
	1 I	
	351 D	
	54 C	
	400 A	
	1 F	
	85 B	
	351 B	
YEAR THREE	351 A	
	1 C	
	1 D	
	1 H	
YEAR FOUR		411 B
YEAR FIVE		411 A

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